# Field and Aircraft Observations in Support of DESDynI

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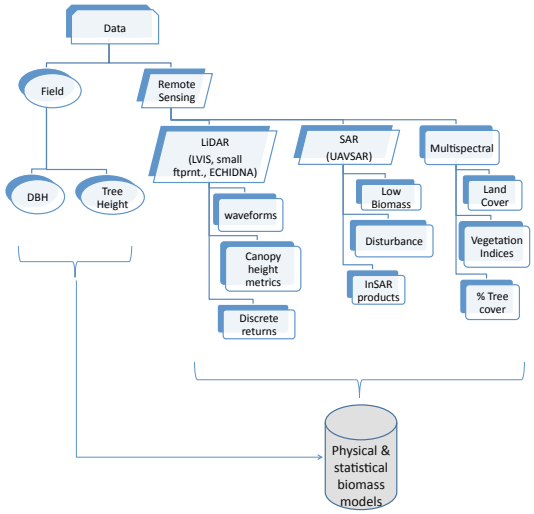
## Background

**DESDynI (*Deformation, Ecosystem Structure and Dynamics of Ice*)** is a NASA satellite mission that will provide global estimates of aboveground biomass and ecosystem structure using LiDAR (Light Detection and Ranging) and L-band radar. LiDAR waveforms and radar backscatter coefficients at different wave polarizations are sensitive to forest height, structure, and composition, and can be used to make quantitative estimates of standing biomass/carbon stocks and ecosystem structure for biodiversity and habitat assessment.

Field and aircraft observations in support of DESDynI for terrestrial ecosystem science have been collected at the La Selva Biological Research Station in Costa Rica, in the Sierra Nevada and New England regions of the USA. DESDynI Airborne simulators include the Laser Vegetation Imaging Sensor (LVIS) and Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR), which provide full waveform LiDAR returns and quad polarization L-band radar data, respectively. Ground-based data include forest inventories; leaf reflectance spectrum; and vertical/horizontal distribution of canopy elements by visual observation, hemispheric photography, and ground-based LiDAR.

## Co-incident Field & Airborne Data Schematic Diagram




## Data Links and Availability

Data and links available at North American Carbon Program website.

A Core Element of the U.S. Global Change Research Program
North American Carbon Program
Continental carbon budgets, dynamics, processes, and management

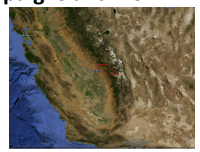
http://www.nacarbon.org

Peter Griffith (NACP Coordinator)
*peter.c.griffith@nasa.gov*

## Regional Field Campaigns and PIs

New England, 2009

Jon Ranson, Penobscot
*jon.ranson@nasa.gov*
Sassan Saatchi, Howland
*sasan.s.saatchi@nasa.gov*
Paul Siqueira, Harvard
*siqueira@ecs.umass.edu*
Ralph Dubayah,
Bartlett and Hubbard Brook



Sierra Nevada, 2008

Ralph Dubayah
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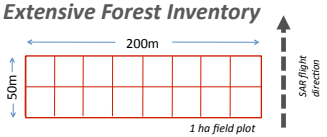
La Selva, Costa Rica 2005/2010

David Clark
*dbclark@sloth.ots.ac.cr*

## Field Data

### *Extensive Forest Inventory*




- GPS used to establish center transect
- Compass and tape used to form subplot boundaries
- Species, live/dead status, and DBH recorded for all trees > 10cm
- Small stems (<10 cm) sub-sampled within 1m of plot centerline
- Height of 3 tallest trees measured in each subplot

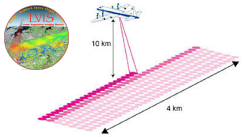
### *Intensive Measurements of Vegetation Structure*

**ECHIDNA (ground-based LiDAR)**

- Hemispheric scans
- 3D Stem/Foliage distributions
- Derived wood volumes

Alan Strahler (PI)
*alan@bu.ed*
*http://www-modis.bu.edu/lidar/introduce.html*

## Airborne Data




**LVIS (full-waveform LiDAR)**

- 25m footprint
- Wall-to-wall scanning
- Areal coverage ~43,000 ha site$^{-1}$

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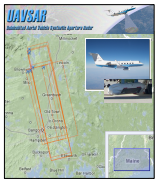
http://lvis.gsfc.nasa.gov




**UAVSAR (quad-pol, L-band radar)**

- 10m pixel
- Areal coverage ~150,000 to 250,00 ha site$^{-1}$

Marc Simard (PI)
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http://uavsar.jpl.nasa.gov

## Summary Statistics and Ongoing Analysis

### Site Totals

| Study Sites | Area sampled (ha) | Trees measured (#) | Largest DBH (cm) | Tallest tree (m) |
|---|---|---|---|---|
| Bartlett | 9.06 | 6,444 | 331.6 | 41.70 |
| Harvard | 15.01 | 10,088 | 136.9 | 28.04 |
| Howland | 12.00 | 7,818 | 134.0 | 39.25 |
| Hubbard Brk. | 10.50 | 5,972 | 92.0 | 39.50 |
| Penobscot | 11.97 | 8,972 | 88.8 | 36.70 |
| Sierra Nevada | 8.00 | 2,345 | 546.0 | 90.00 |

**Fig 1. Biomass distributions (subplot-level)**

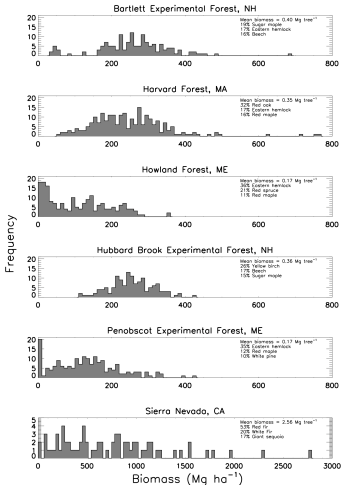


**Figure 1** (right). Distribution of biomass estimates derived from field measurements during the 2008/09 campaigns.

Biomass density is shown at the subplot-level for stems < 10 cm DBH.

The NASA/NACP database contains plot coordinates; data for individual trees; biomass calculated from general equations of Jenkins *et al.* (2004); and subplot summary statistics.

**Figure 2** (right). Stems <10 cm diameter in New England forests contributed up to 50% of the total biomass, and binned averages were up to 30 to 40 Mg ha$^{-1}$ in low-density subplots.

**Fig 2. Biomass contribution by stems <10 cm**

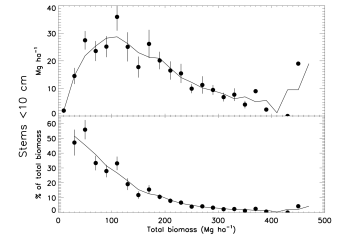


**Figure 3** (below). Data are being used to develop algorithms for deriving forest biomass from LiDAR, radar, and LiDAR/radar fusion.

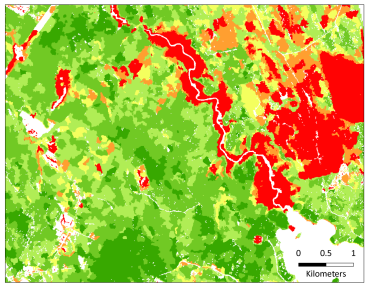


**Fig 3. Preliminary fusion product for Penobscot Exp. Forest, ME.**

**Biomass (Mg ha$^{-1}$)**

- 6 - 50
- 51 - 75
- 76 - 100
- 101 - 150
- 151 - 200
- 201 - 310